THE BEST TECHNIC FOR GASTROENTEROSTOMY AS DETERMINED BY FUNCTIONAL RESULTS.

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For a number of years the operation of gastroenterostomy has been gradually losing in favor, and at the present time dissatisfaction with this surgical procedure is approaching an extreme point. It has therefore seemed to be of value to summarize observations made on patients subjected to this operation with the object of demonstrating the accompanying and resulting phenomena; these seem to explain amply the reasons for this dissatisfaction. And inasmuch as the making of a gastroenteric anastomosis is on occasion a necessity, the observations have further value in enabling a selection of the best type of technic for this purpose. It seemed best to utilize only the clinical notes and observations of patients actually afflicted with ulcerative conditions; animal work did not seem appropriate, since none of the ordinary laboratory animals are naturally susceptible to this disease.

The methods employed in making these studies depends upon the estimations of the functional capacity of the stomach and were fully described on a previous occasion. Inasmuch as gastroenterostomy is most frequently made for chronic ulcerations of the stomach or duodenum, none other than these ulcer cases, except for the control cases, are included in the report. The patients upon whom these studies were made were not selected in any way and the studies were made *seriatim* as the patients were consecutively admitted and discharged.

The necessary control observations were made by selecting a number of patients in whom at exploratory operations it was definitely established that no pathologic lesion existed in the stomach or duodenum. The observations made in these cases before and after operation showed close similarities. The facts of these observations are summarized in Table I and Fig. 1. In detail these are:

TABLE I.

MOTOR FUNCTION.

Case.	Roentgen-ray.		
	Tone.	Peristalsis.	Empty in.
1	Good	Active.	4 hours.
3	Good	Active	4 hours.
4	Good	Active	6 hours.
2	Fair	Fair	6 hours.
6	Good	Active	6 hours.
7	Good	Active	6 hours.

CHEMISM.

Case.	Fasting contents; residue in cc.	Ewald test-breakfast.			Riegel test-meal; residue in cc.
		Residue in cc.	Free acid.	Total acid.	
1	0	40	35	65	0
3	0	100	50	75	0
4	0	60	. .	. .	0
2	0	75	35	75	0
6	0	50	60	80	0
7	0	35	30	60	0

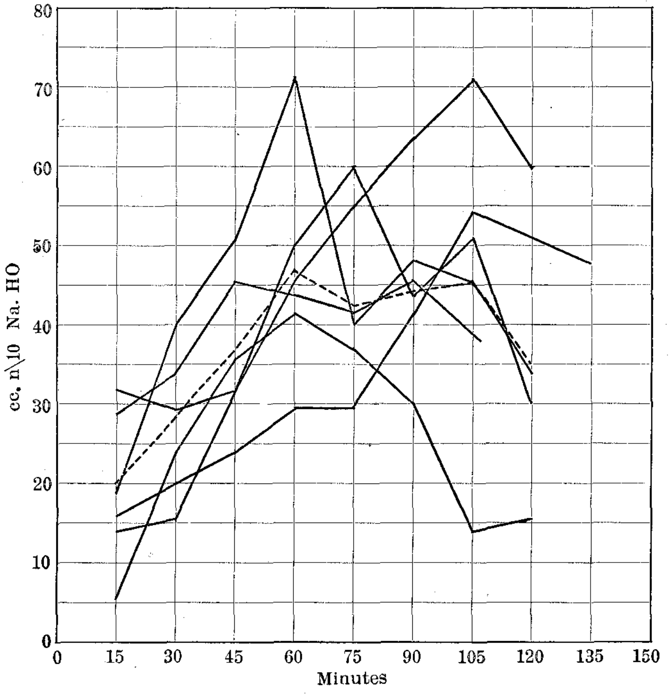

FIG. 1.—Fractional test meal. Specimens extracted until the stomach is empty. Estimations in terms of cubic centimeters of decinormal sodium hydrate solution. The dotted line represents the average of all the curves in the figure. These facts apply to Figs. 2, 3 and 4 also.

1. There is no fasting contents in the stomach or, at most, it consists of a few cubic centimeters. The latter is mostly mucus, more rarely a thin watery fluid, and very rarely is bile-tinged. It usually contains no or very little free hydrochloric acid and a low total acidity. Frequently there is no acid content.

2. After an oatmeal gruel test meal hydrochloric acid is secreted rapidly and the total concentration rises and reaches its maximum approximately sixty minutes after ingestion. Thereafter the total concentration tends to fall and approach the level from which it began.

3. The secretion of digestive enzymes is constant and the latter can always be demonstrated in abundance.

4. Depending on the character and quantity of food the stomach is emptied after a certain time and afterward the stomach contents resemble the original fasting contents. With carbohydrate meals the average emptying time is from two to three hours; with protein meals, six hours or more.

5. The motor activity of the stomach wall is normal. The roentgen-ray demonstrates that peristalsis is active and efficient; with the barium zoölak contrast meal the stomach is seen to be empty within six hours.

These are the salient characteristics of normal stomachs.

The biologic history of chronic ulcer of the stomach or duodenum includes definite manifestations of disturbances in the normal physiologic activities. In previous studies these were all severally considered. It was possible to demonstrate that functional disturbances were not always present to any considerable degree and that there was no elicitable relationship between the situation of the lesion, its size or structural characteristics, or of any anatomic complication, and the character and intensity of the physiologic changes and of the subjective symptomatology. Without going into any detailed description of these relative factors the progression of the illness is, in the large majority of cases, accompanied by a progressive increase in the functional disturbance; this is especially marked in the motor aspects.

There are several ways of making a gastroenteric anastomosis and the procedure may be added to by creating an artificial blocking to the passage of the stomach contents through its normal outlet (unilateral pyloric exclusion). The operation usually done follows the method of von Hacker, and the anastomosis is made either by suture or by the Murphy button, depending on the ease with which either could be done or on the exigencies of the individual case; preference has always been given to the suture method. With the suture method the stoma is made large enough to easily admit two fingers, and is given a vertical application to the posterior wall of the stomach, as near to the pyloric end and the greater curvature as can easily be reached through an opening in the mesocolon made to the left of the middle colic artery. The afferent loop is as short as possible. The efferent loop is most commonly turned to the right and passes downward and to the right in the general direction of the right iliac fossa. In exceptional cases the efferent loop is allowed to follow its natural inclination; it then passes downward and to the left in the general direction of the left iliac fossa. The pylorus is always excluded by the string method unless sufficient stenosis of its lumen already preëxists.

The operation of gastroenterostomy causes a distortion of the normal structure and contour of the stomach and of its anatomic relationships. This probably secondarily causes changes in the normal nervous mechanism controlling the normal gastric functions. Even when all the wounds are surgically healed in a manner most acceptable in the present state of our knowledge certain changes in the physiology are therefore inevitable because of this new anatomy. When superimposed upon the previously existing anteoperative deviations from the normal physiologic function the effects of the operation may be one of two: In many the immediate influence is of a beneficial nature and is amply demonstrated both by the subjective symptomatology and by the objective functional capacity of the stomach as determined by appropriate laboratory tests. In some the resultant immediate effect shows no improvement in the functions of the stomach from its preoperative status. In a very few an exaggeration of the latter status appears usually approximately equal to the old disturbances plus those due to the changed anatomy. The possible combinations probably furnish a very fertile field for the presence of postoperative symptoms.

This conception furnishes a ready explanation for the good results which usually follow a gastroenterostomy done for cicatricial pyloric stenosis; here an anatomic abnormality existing for a long period of time has caused accompanying changes in the normal physiologic mechanism, the progression of which holds an almost mathematic ratio with the degree and duration of the stenosis. After a certain time the disability reaches the point where the exhibited compensatory efforts of the stomach eagerly await a change in structure sufficient and competent to enable the organism to adjust itself satisfactorily to the new conditions. The gastroenterostomy accomplishes this in the most desirable way, and the postoperative compensation is therefore made with no or very little symptomatic disturbance.

The changes which follow gastroenterostomy have a wide latitude and can be considered from various viewpoints. The functional results were preliminarily studied without regard to the type of technic employed in the operation or to the secondary changes which had followed the essential ulcer pathology. Several tables are appended in which this knowledge is summarized[1] (Fig. 2, 3 and 4).

Table II consists of cases in which at the time of the examination there were no subjective symptoms of any kind.

TABLE II.

MOTOR FUNCTION.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
4	Closed	Patient	Good	4 hours.
10	Patient	Patient	Fair	6 hours.
16	?	Patient	Good	6 hours.
19	?	Patient	Good	4 hours.
6	Patient	Patient	Good	?
22				

CHEMISM.

	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
Case.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
4	30	0	18	225	24	54	?		
10	30	4	10	70	50	86	0		
16	5	0	0	20	0	56	0		
19	10	0	0	60	0	14	?		
6	70	0	10	80	0	12	?		
22	25	10	22	75	16	46	?		

Table III includes cases in which an exhibition of symptoms indicated an incomplete readjustment to the new conditions either because of insufficient compensatory effort or because of the preoperative extraordinary degree of derangement. The studies seemed sufficient to make the assumption probable that no anatomic lesion was present. The degree of individual disturbance as indicated by the symptomatology showed wide variations.

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[1] These tables should not be interpreted as indicating in any way the number or percentage relationships of the cases cured or not cured.

TABLE III.

MOTOR FUNCTION.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
2	Patent	Closed	Active	6 hours.
32	Patent	Patent	Active	6 hours.
5	Patent	Closed	Very active	?
12	Patent	Patent	Very active	¾ in 1 hour.
11	Patent	Not efficient	Very active	6 hours.
9	Patent	Not efficient	Fair	6 + hours.

CHEMISM.

Case.	Fasting contents.			Ewald Test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
2	25	10	22	220	38	63			
32	25	12	30	60	16	65	40	14	30
5	90	46	48	300	44	64			
12	16	10	25	160	11	45			
11	65	21	41	125	36	68			
9	1	0	0	350	14	51	100	0	55

Table IV includes cases in which at secondary exploratory operations it was definitely proved that the symptomatology was directly due to anatomic lesions. In these cases also the degree of disturbance as indicated by the subjective symptomatology showed wide variations.

These tables demonstrate rather conclusively that the operation of gastroenterostomy, even when the postoperative course is seemingly ideal from every standpoint, is followed by certain changes in the physiologic mechanism of the stomach. The changes involve both the motor and chemical functions of the stomach, and it is not easy to distinguish the relative positions of either. It seems, however, from all that one knows that the motor function is most important for the proper working of the stomach; and it is more than probable that in many, if not in all, the chemical changes are secondary to the motor. The direction which the latter assume is toward a progressive retardation of the passage of the stomach contents onward in the alimentary canal.

With the appearance of postoperative symptoms of one kind or another a study of the individual functions indicates that the degree of physiologic derangement becomes progressively greater as the attempted readjustment is retarded or disturbed because of functional causes and reaches a maximum when the compensation is interfered with by the presence of mechanical obstacles to the proper motor functioning of the stomach (narrowing of the stoma in the presence of a spontaneous or operatively produced pyloric obstruction).

TABLE IV.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
13	Patent	Not seen	Violent	6 + hours.
3				
14	Patent	Not seen	Violent	6 + hours.
18	Patent	Patent inefficient	Hyperperistalsis	?
24	Patent	Inefficient	Hyperperistalsis	6 + hours.
27	Patent	Patent	Active	6 hours.

CHEMISM.

Case.	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
13	44	8	21	190	30	64			
				450	30	50			
3	60	12	46	90	24	66	27	0	73
14	60	27	54	210	34	52			
18	50	27	41	200	39	53			
24	10	0	0	600	33	50	30	0	18
27	..	..	..	20	17	35	50	46	86

It seems to be true that in many of the cases in which these deviations from the normal take place the change becomes permanent. In a series of cases which were studied for periods up to four years after operation it could be demonstrated that while the chemical function remained practically in the same condition in which it was prior to operation the delay in emptying time, as demonstrated by test meals, persisted and grew larger as time went on. This is well shown in Table V. The roentgen-ray is not very reliable for determining this point, inasmuch as frequently the passage of a stomach tube is productive of stomach contents when no contrast meal is visible either fluoroscopically or on a photographic plate.[2]

TABLE V.

EWALD TEST-BREAKFAST.

	Residue in cc.	Free acid.	Total acid.
Before operation	74	47	72
1 to 4 months postoperative . .	127	27	61
4 to 12 months postoperative . .	148	27	54
1 to 4 years postoperative . .	190	32	60

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[2] I am indebted to Dr. Held for this observation.

The subject under discussion might also be viewed with reference to the type of technic employed in the operation of gastroenterostomy. As indicated in the beginning of this communication this would enable a selection of that method of operating for routine purposes which would be followed most often by a minimum change from the normal standards; it was hoped that in that way the temporary or permanent disagreeable sequelæ, especially those in the period of readjustment after operation, might be obviated altogether or minimized as far as possible.

In most clinics the principal technics employed in gastroenterostomy include (*a*) posterior gastroenterostomy by suture or (*b*) by the Murphy button; (*c*) either of these in combination with a pyloric exclusion. The observations hereinafter summarized have to do with these three types of technic. In those cases in which ulcers were found and operations were done upon the stomach the patients were allowed to recuperate completely Then the functional capacity of the stomach was again determined in the manner previously alluded to.

In the suture gastroenterostomy cases in which no pyloric exclusion was practised the obtainable facts are gathered in Table VI and Fig. 2.

TABLE VI.

MOTOR FUNCTION.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
1	Open	Patent	Active	9 hours.
12	Open	Patent	?	¾ in 1 hour.
14	Open	Patent	Violent	6 hours.
25	Open	Patent	Very active	6¼ hours.
46	Open	Patent	Good	Over 6 hours.
64	Open	Patent	Good	Over 6½ hours.

CHEMISM.

Case.	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
1	60	0	14	100	4	8			
12	20	16	25	160	11	45			
14	80	27	54	210	34	52			
25	25	18	31	70	32	94	25	36	62
46	35	42	60	40	30	50	0		
64	5	0	0	110	11	42	5	0	0

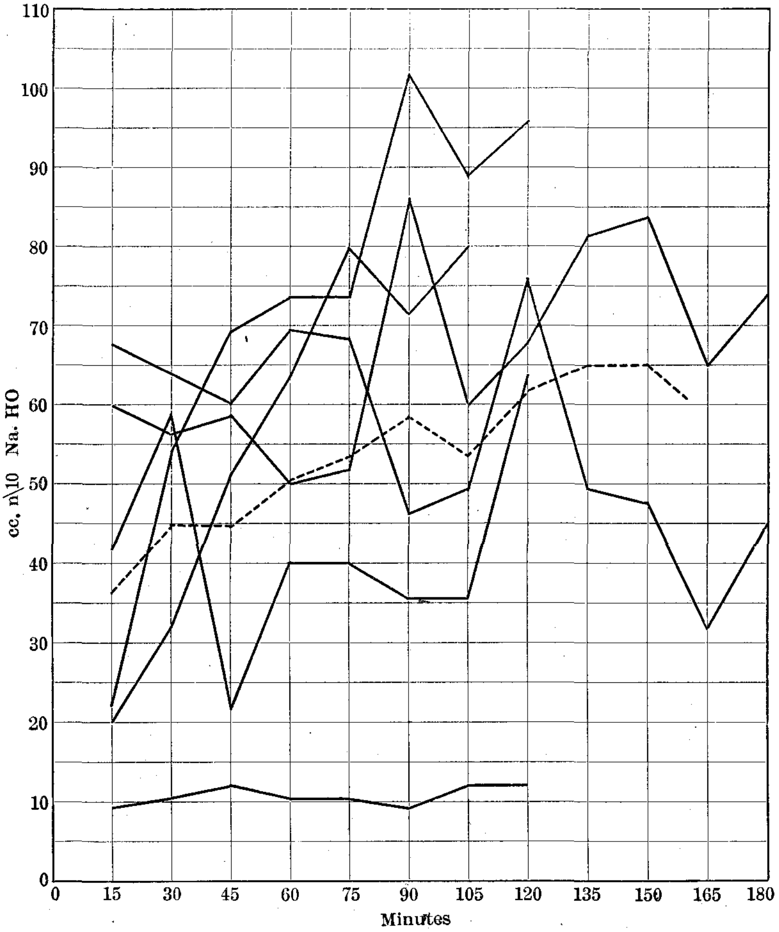

Fig. 2

In the second group of cases a pyloric exclusion by the string method was done in addition to the suture gastroenterostomy. The elicitable facts are summarized in Table VII and Fig. 3. A comparison of the observations in this group with those in the previous group enabled an evaluation of the effect of the string method of pyloric exclusion.

TABLE VII.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
4	Closed	Patent efficient	Good	4 hours.
2	Open	Not patent	Moderate	6 hours.
17	Closed	Patent	Fair	6+ hours.
39	Open +	Patent ++	Good	6½ hours.
53	Closed	Patent	Fair	6½ hours.
66	Closed	Patent	Fair	6 hours.

CHEMISM.

Case.	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
4	27	13	30	350	20	45	60	0	27
2	26	10	22	200	38	63	58	0	16
17	75	22	40	150	50	71	70	58	83
39	30	60	80	110	68	96	40	14	50
53	0	..	..	265	30	48	0		
66	0	..	..	100	15	60	50	38	47

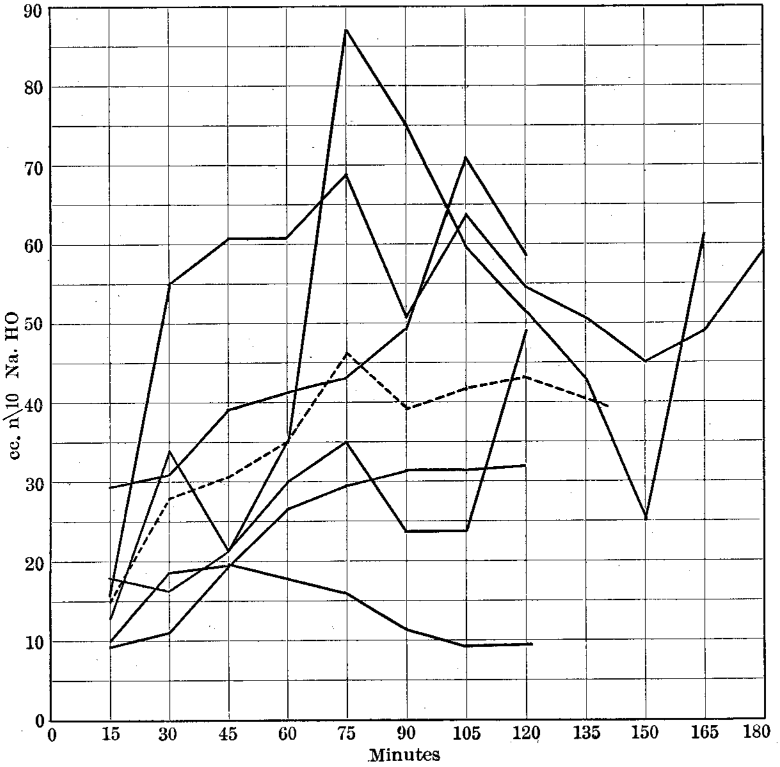

FIG. 3

In the third group the gastroenterostomy had been made with the aid of a Murphy button and a pyloric exclusion had been made with the technic described in the previous paragraph. The facts are grouped in Table VIII and Fig. 4. A comparison between the second and third groups enabled a judgment as to whether the suture or button operation was superior.

TABLE VIII.

MOTOR FUNCTION.

Case.	Roentgen-ray.			
	Pylorus.	Stoma.	Peristalsis.	Empty in.
10	Open ++	Patent +	Good	6 hours.
16	?	Patent	Good	6 hours.
22	Closed	Patent	Active	6 hours.
48	Open	Not seen	Fair	
55	Open	Not seen	Fair	6 hours.
50	Closed	Patent	Active	6 hours.

CHEMISM.

Case.	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
10	30	4	10	70	50	86	0		
16	5	(mucus)	..	100	0	50	0		
22	16	0	?	70	4	50	15	34	52
48	0	..	..	180	66	88	35	34	52
55	15	8	24	150	38	76	50	68	90
50	0	..	..	30	28	52	90	56	74

The average findings in the three groups studied are compared in Table IX. In a general way these observations correspond with those noted in the earlier tables; there are larger residues after the various test meals, and the general run of acid concentrations does not show much deviation. In the individual groups it is to be noted in most of the cases that the suture operations yield a larger residue after the test meals when an exclusion has been simultaneously practised. In contradistinction to these two groups of suture operations the button operations seem to yield residues which more nearly approach the normal. The smallest fasting stomach contents is obtained after the button operation. The average functional result after a suture operation without an exclusion seems to equal that of a button operation with an exclusion.

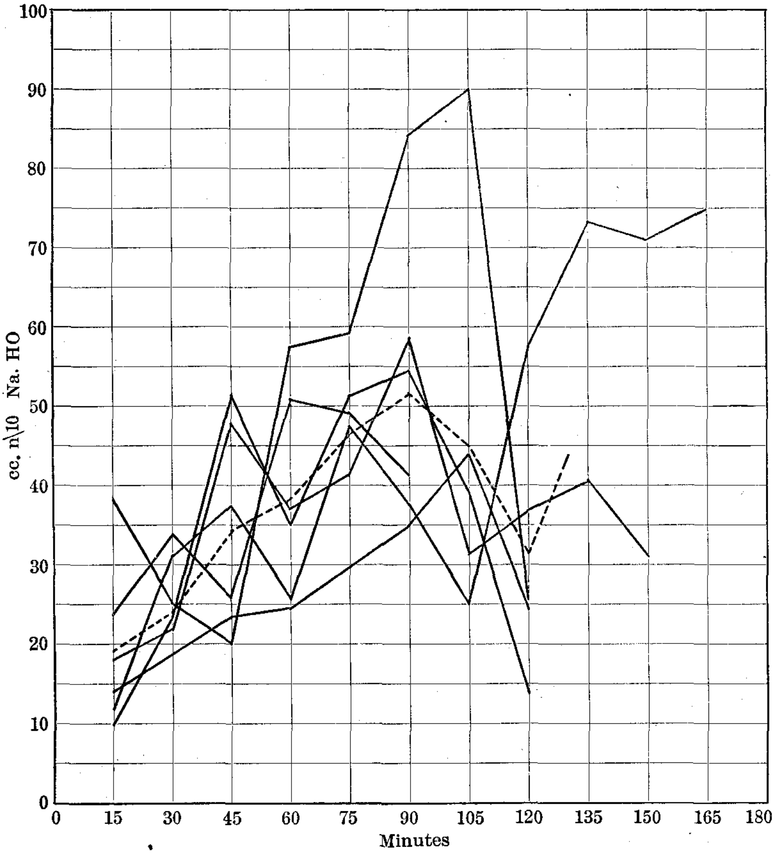

Fig. 4

TABLE IX.

Motor Function.

Table.	Roentgen-ray.				Emptying time by fractional test meal.
	Tone.	Stoma.	Peristalsis.	Empty in.	
1	Good	..	Active	5⅓ hours.	2 hours, 5 minutes.
6	Good	..	Very active	6⅗ hours	2 hours, 9 minutes.
7	Fair	..	Moderate to fair	5⅔ hours	2 hours, 22 minutes.
8	Good	..	Active	6 hours	2 hours, 5 minutes.

Chemism.

Table.	Fasting contents.			Ewald test-breakfast.			Riegel test-meal.		
	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.	Residue in cc.	Free acid.	Total acid.
1	0	..	..	50	35	59	0		
6	37+	17+	30+	115	20	48+	10	18	31
7	26+	26+	53	177+	36+	63+	46	22	44+
8	11	6	17	100	31	65+	31+	48	69+

After a suture operation the roentgenographic evidence indicates that peristalsis becomes excessive and in some cases violent. Even with this increase in muscular effort, however, the total effect as regards the emptying time of the stomach does not show any appreciable advance over the preoperative status; in some, indeed, it is lengthened. When an exclusion has been practised the muscular effort gives evidence of some inhibition. In either case it seems that the total efficiency of the stomach as a machine whose function is to empty itself in a given time, is disturbed. With the button operations the roentgenographic evidence indicates that the contractions of the stomach wall most nearly approaches the preoperative normal standards, and the total efficiency seems least disturbed.

When considering these observations from the point of view of the kind of operation employed it becomes necessary to give much attention to the size of the stoma, to the ease with which stomach contents can engage in its lumen and pass onward in the alimentary canal, to the presence or absence of an open pylorus, and to the presence or absence of deformity of gastric contour. In the cases discussed in this communication no case with any deformity of contour has been included. The cases with spontaneously produced and preëxisting pyloric stenosis were also discussed previously. In the acute pyloric occlusion produced in the exclusion operation the evidence indicates that some disturbances may be expected owing to the fact that the stomach is not adequately prepared for this anatomic change; time must be given for complete compensatory readjustment.

The physical characteristics of the stoma are matters of importance in its proper functioning. It is important that no spur be created and that no superabundance of gastric mucosal folding be present and capable of falling across the mouth of the stoma with the formation of a valvular mechanism; in either case the passage of stomach contents would be impeded. The size of the stoma is most important. When studying the subject with the roentgen ray it is to be noted that in some of the cases the major portion of the contrast meal pours through the stoma in a large stream into the small intestine at a very rapid rate; the stomach is practically empty in a comparatively few minutes. In others of the cases a small amount remains in the stomach after the initial rapid outpouring of the contrast meal, and for some unaccountable reason takes a comparatively long time to be evacuated completely. Clinically the cases with such rapid outpouring and emptying frequently have distressing symptoms. In these cases the stoma is manifestly too large. Many experiences have indicated that a stoma which is too large is just as bad—if it be not worse—as one which is too small; a happy medium is desirable.

In fashioning the stoma with the button the finally resulting opening is just large enough to admit an average-sized forefinger. This corresponds rather accurately with the size of the normal pylorus. The opening made with the suture method is always much larger than this; in most clinics the stoma is made large enough to admit easily two average-sized fingers. This means a very large difference when one takes into account the number of muscle and nerve bundles divided; with the button a small incision is made and the latter is then bluntly dilated sufficient to admit the button; with the suture much more than two fingers' breadth must be cut in order to allow for subsequent contraction. I am inclined to think that for this reason the functioning of a button stoma shows a nearer approach to the normal standard; its action more nearly approaches that of the pylorus.

Summary. Evidence is presented which seems to show that the functional result of a gastroenterostomy made with the aid of a Murphy button is superior to that of a gastroenterostomy made by the suture method.

THE MALE SEXUAL GLAND IN THE PREVENTION OF CREATINURIA.*

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The perplexing problems of the origin and intermediary metabolism of creatin and the factors influencing its excretion have not been definitely solved, in spite of the mass of investigative work. Creatin is found normally in animal tissue, specially muscle, in the urine of children, and occasionally in the urine of normal women. Only under certain pathologic conditions, such as fasting, cachexia, febrile disease, hyperthyroidism, diabetes mellitus, myopathies and so forth does the adult male excrete creatin. "Since creatinuria disappears at puberty, and does not occur in normal man, a hitherto neglected factor for its excretion obtrudes itself, namely, the influence of the male sexual gland.[1]"

In order to determine the effect of castration on the creatin excretion of the rabbit, experiments initiated August 1, 1920, were carried out at the Sprague Memorial Hospital of Chicago, in conjunction with Dr. George H. Jackson, Jr. In some instances there was a pronounced increase of creatin excretion on the second day following castration, and possibly a slight persisting increase lasting forty-five days. These experiments were controlled by

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* This work was undertaken at the suggestion of Dr. S. Amberg, to whom I wish to acknowledge helpful suggestions given during the course of the study.